Examining Growth Patterns of Starter Cultures in Swiss Cheese

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INTRODUCTION

- Swiss cheese is a semi hard cheese with holes, or “eyes” [1]

Fig 1. Major Swiss cheese production stages.

- Swiss cheese production involves two main flora: thermophilic lactic acid bacteria (LAB) and propionic acid bacteria (PAB) [2].
- LAB includes *Streptococcus thermophilus* and *Lactobacillus* spp. and produce lactic acid [3].
- PAB includes *Propionibacterium freudenreichii* utilizes lactic acid produced by LAB and produces carbon dioxide as a byproduct, which then creates holes or “eyes” in Swiss cheese [3].
- Starter cultures contribute to the distinctive texture, sweet-nutty flavor, and eye-production [2].

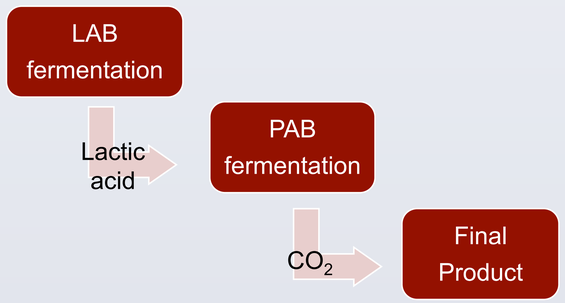

Fig 2. Fermentation sequence during Swiss cheese manufacture and key byproducts of fermentation..

- Understanding growth of LAB and PAB are important because their growth and metabolism are directly associated with fermentation and quality of Swiss cheese.

OBJECTIVE

The objective of this study was to quantify and examine growth patterns of starter cultures in Swiss cheese.

HYPOTHESIS

It was predicted that LABs would display high growth at the after press and PAB would grow optimally at between after pre-cool and warm room stages.

METHODS

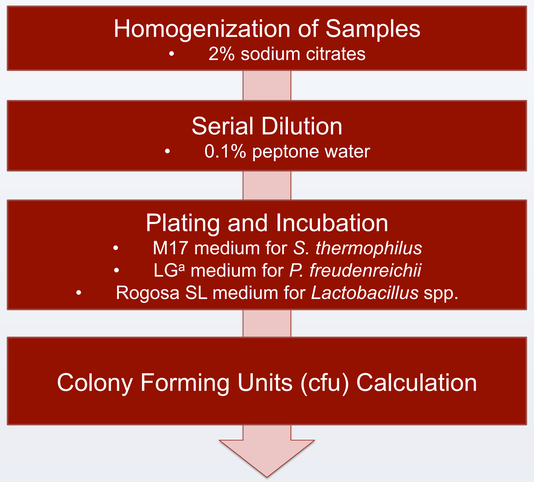

Fig 3. Diagram of experiment procedure
[a] Lithium glycerol

- M17 and LG agars incubated anaerobically at 37ºC for 3~5 days
- Rogosa SL agar incubated anaerobically at 30ºC for 3~4 days.
- Cfu/g was calculated using the following equation: [(number of colonies) / (dilution factor)*plated on agar (volume)].

RESULTS

- Company A: a slight decline in growth of *Lactobacillus* spp, but its growth was not statistically different
- Company B: *Lactobacillus* spp. showed highest growth at the after press stage and its growth was not statistically different after. .

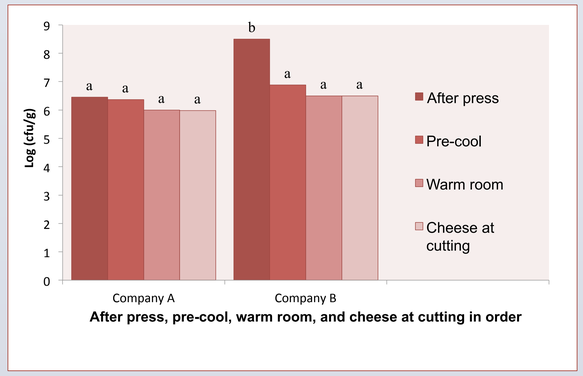

Fig 4. Comparison of growth patterns of *Lactobacillus spp.* at after press, pre-cool, warm room, and cheese at cutting stages between companies.
[a-c] Different letters indicate significant differences between processes

- Company A: *S. thermophilus* showed no statistical variance until the cheese at cutting stage.
- Company B: growth of *S. thermophilus* showed a decline after after press stage and remained similar.

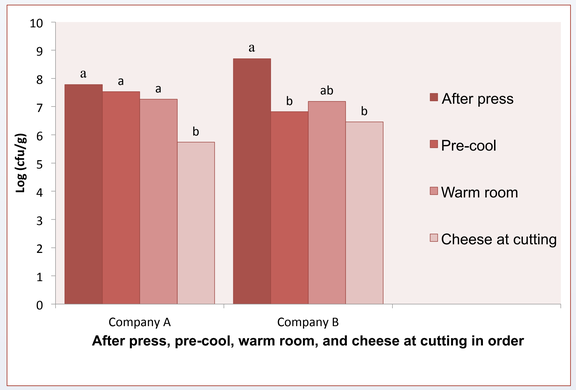

Fig 5. Comparison of growth patterns of *S. thermophilus* at after press, pre-cool, warm room, and cheese at cutting stages between companies.
[a-b] Different letters indicate significant differences between processes

- For company A, growth of *P. freudenreichi* was highest at the after press stage and its growth declined gradually.
- For company B, highest growth was seen at the pre-cool and warm room stages.

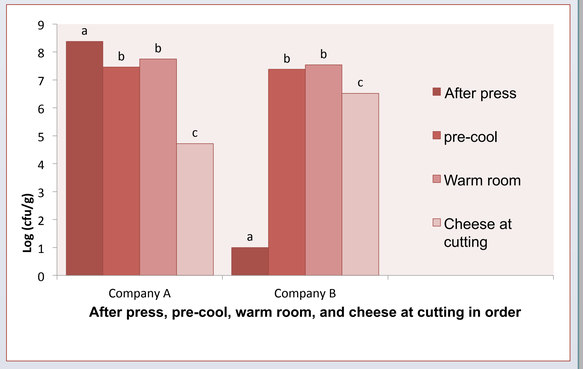

Fig 6. Comparison of growth patterns of *P. freudenreichi* at after press, pre-cool, warm room, and cheese at cutting stages between companies.
[a-c] Different letters indicate significant differences between processes

DISCUSSION

- Company A and B displayed slightly different growth profiles of each bacterium.
- Different growth patterns between company A and B could be associated with their specific bacterial strains and production conditions such as batch size, equipment setting, etc.

- Overall, highest microbial population was seen at the after press stage for both LABs and PAB starter cultures.
- In addition, there was a decline of microbial population towards the cheese at cutting stage.
- Decline of microbial population could represent flavor, aroma, and texture development from chemical properties of byproducts of LAB and PAB fermentations, not from microbial growth.

CONCLUSIONS

Fermentation of each bacterium was at its peak at the after press stage and microbial populations showed a general decline towards the cheese at cutting stage. Slightly different growth profiles of starter cultures observed from this study could contribute to each company’s distinctive flavor, aroma, or texture of Swiss cheese.

FUTURE DIRECTIONS

The results obtained from this study could potentially guide further study to measure byproducts of fermentation of each bacterium and analyze how they might contribute to the ripening or flavor development of Swiss cheese.

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[3] McSweeney PLH. 2004. Biochemistry of cheese ripening. Int. J. Dairy. Technol. 57: 127-144.

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